

Massachusetts Institute of Technology
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SUNDANCE Memo #86 and LUMINARY Memo #56

TO: Distribution
FROM: George W. Cherry
DATE: December 3, 1968
SUBJECT: SUNDANCE and LUMINARY Program Activities Calendar

This is a calendar of some LM Program activities going on or needing to start. This memo schedules meetings to plan some of the activities which must be started or closed out. There are several action items embedded in this memo

I. SUNDANCE Activities

A. Level 6 (Mission Verification) for Mission D.

This activity must be completed by 17 January 1969 to support the FSRR (Flight Software Readiness Review). The FSRR is presently scheduled for 20 January 1969. Level 6 has three main categories of activities.

1. AGC Performance Tests.

Some work is presently going. Nyles Barnert, Rama Aiyawar, Sam Frank and Blake Ireland are carrying out this work with Gene Muller supplying initial conditions, suggestions for tests, navigation schedules, etc. The "D" Tincan trajectory has been run, for example. The following work must be accomplished in this area.

- a. A definitive AGC performance test description (action to Gene Muller - need date 10 Dec 1968) and

- b. Personnel Assignments
to accomplish tests (action to Dan Lickly or Jim Kernan - need date - 11 Dec 1968). This information will be incorporated into the "D" Mission Development Plan. The information exchanged at the MSC meetings on "D" level 6 will be used, of course. These meetings are scheduled on 5, 6 December 1968. Norm Sears and I are attending and will fill Gene and others in.
- c. Special DAP Test
APS burn to depletion (Action to Bill Widnall, Dick Goss? - need date: 8 January 1968).
- d. DAP Edit programs
to be run on all AGC Performance Tests (Action to Bill Widnall - need date: 12 December 1968).
- e. Downlink edit programs
to be run on all AGC Performance Tests (Action to Jim Kernan - need date: 12 December 1968).
- f. Modifications to Performance Edit Programs
(Action for definition to Gene Muller - need date: 5 December 1968. Action for edit program additions to Nyles Barnert - need date: 12 December 1968).
- g. Complete Final Documentation of AGC Performance Tests
(Non-DAP action to Gene Muller - need date: 17 January 1968. DAP Action to Bill Widnall - need date 17 January 1968).

In order to promote and report progress in the above areas we will begin a weekly Level 6 SUNDANCE meeting. At the meeting we will review test results, discuss problems, discuss program notes, update the development plan etc. At the first meeting - which will probably be scheduled for 13 December 1968 or 16 December 1968 - we will review the test plan (prepared by Gene) and the edit program requirements, in order to plan exactly what should be in each run deck and how many run decks there should be.

We should make a spare copy of every run and ship it to Bob Spaulding (MSC) for perusal by MPAD. MPAD really looks at these runs. We found out at the LUMINARY FACI review that they actually duplicated many AGC runs on their engineering simulator.

2. Special Tests.

Most of the special tests will be scheduled for the hybrid and the hybrid testing will be somewhat open-ended to allow new tests to be added as we think of the need for a special test. However we still want to inject some discipline into this area and officially describe and schedule most of the special tests in our mission support development plan for Mission D. Examples of this category of testing would be special downlink tests if needed, re-start testing, P37 DSKY options, extended verbs keyed in at various times, checks for numerical difficulties in navigation or V83 at close range, etc. The sources of the special tests will be sixfold.

- a. Suggestions for further tests made by MSC at the LUMINARY Pre-FACI review. Many of the suggestions made by MSC for LUMINARY - especially in the burn and rendezvous and rendezvous radar areas - are applicable to SUNDANCE (Action for definition of applicable tests to Jim Kernan - need date: 13 December 1968).
- b. Suggestions from Experts in the design and operation of the program (Action to individuals below - need date: 13 Dec 1968 for most items).
 - 1) Powered flight: Peter Adler and Pete Philliou.
 - 2) Rendezvous: Gene Muller and Peter Volante.
 - 3) Alignments: Don Millard and Bob White.
 - 4) Targetting: Pat White, Joe Saponaro, and Wayne Tempelman.
 - 5) Lambert and Integration: Bill Ostanek and Bill Robinson.

- 6) Rendezvous Radar: L. B. Johnson, Bob White, and Pete Volante.
- c. Re-start testing. (Action to Dan Lickly, Jim Kernan and the above experts - need date: 20 December 1968).
- d. Suggestions or requests from MSC (for example, the Data Priority meeting via Malcolm Johnston). (Action to Mal Johnston - Mal, if you have any suggestions, please get them in to me.)
- e. Suggestions from the MPE. (Steve, if you have any suggestions, get them in to me.)
- f. Special Downlink Tests. (Action to Jim Kernan - need date: 13 December 1968)

3. Mission Procedural Verification

This is presently scheduled to be finished on 10 January 1969 which is consistent with the FSRR. Documentation should be available on 17 January 1969. (Action to Jim Nevins, Ivan Johnson, Sam Drake.)

B. GSOP Activities, Program Notes and Other Documentation (User's Guide?)

Some of the GSOPs require change pages because of PCR's and documentation errors. The pertinent PCR's are:

1. PCR's Requiring Change Pages.

PCR 612.1	Raise Threshold for DELTAV Monitor
PCR 601	Verb 61 Correction
PCR 593.1	Modify ARCSIN-ARCCOS Alarm(1301) To Avoid Hard ware Re-start
PCR 592	Reduce Restrictions on Running R04
PCR 587.1	APS and DPS Tail-Off Constants
PCR 573.2	A _x and A _y Polarity in Planetary Inertial Orientation Subroutine
PCR 540.2	Active Vehicle Control Angle in CSI-CDH
PCR 518	Correction to R30

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| PCR 513 | Correct Exit From R33 |
| PCR 512 | Correction to R00 |
| PCR 500 | RR Search Termination |
| PCR 483 | Suppress Pitch-Roll Jet Firing During CSM-docked Burns |
| PCR 480 | Move Rendezvous Radar <u>A Priori</u> Variances into Erasable |
| PCR 446.1 | R60 Ball Angle Display |
| PCR 401.3 | Correction of IMU Warm-up Time |
| PCR 226.2 | Change Priority Displays from 5 Second to 2 Seconds |
| PCR 164.2 | Mode II Attitude Error Display |
- a. GSOP Section 4. Final Section 4 change pages for SUNDANCE 306 available for MDRB review. (Action to Fred DeCain - need date: 13 December 1968).
 - b. GSOP Section 5. Final Section 5 change pages for SUNDANCE 306 available for MDRB review. (Action to Bill Marscher - need date: 13 December 1968.)
 - c. GSOP Section 6. Final Section 6 changes pages. (Action to Alex Kosmala - need date: 13 December 1968.)
2. Review of Program Notes issued by the Flight Software Division (Action to Jim Kernan - need date: 20 December 1968.)
 3. A User's Guide made by culling and compiling in one document all the pertinent Mission Techniques Memos, AG letters, SUNDANCE Memos, etc. ? (Action to discuss: Mission Development Division Director, Project Manager, Division Managers. Need date: ASAP.)

C. Scama Room and RTCC Mission Support for "D".

Some of the personnel working on LM programs will be affected. Identifying them as soon as possible will serve to interest them more vitally in any of the above tasks they are responsible for.

II. LUMINARY Activities

NASA/MSD has not yet authorized a LUMINARY 1A or LUMINARY 2 activity. They will have to define a ranked list of proposed items to be added to LUMINARY and specify what date they would like the programs ready for release for flight rope manufacture. We will then figure out how many of the ranked list we can put in and release by MSD's required date.

I have sent a letter to MSD proposing 5 PCR's for LUMINARY 1A and LUMINARY 2 (AG letter #589-68). This letter also gives the latest FSB version of the hopper for LUMINARY 2. Since then I have received about four or five more PCR's from MIT/IL folks interested in program improvement. One of the most noteworthy (I approved it and forwarded to the SCB for consideration already) was submitted by Eyles and Adler. It permits a variable servicer cycle duration permitting, for example, a one-second up-dating of the VG display for trimming. Between this and ASTEER (they fit together exquisitely) the VG bounce should vanish and VG-nulling become a nonchalant exercise.

Another noteworthy change (originating from MSD) is to make the abort injection velocity a cubic function of TFI - one function for P70 and another for P71. This sets up propitious conditions and geometry for the concentric flight plan of rendezvous.

In the meanwhile, however, no LUMINARY 1A and LUMINARY 2 activity is authorized.

LUMINARY must be thoroughly wrung out. Even if we were authorized to build LUMINARY 1A or LUMINARY 2 right now, we should be wringing out LUMINARY. Any changes to make LUMINARY 1A from LUMINARY could then be handled the way we handled making SUNDANCE 306 from SUNDANCE 302, careful custom testing of each change so that the confidence we had built up in SUNDANCE 302 was maintained and even enhanced. Therefore, the first vital activity in LUMINARY is Level 5 testing.

A. Level 5 Testing

(Action to Dan Lickly or Jim Kernan - need date: 20 December 1968.)

I think that I have finally found out what level 5 testing is nowadays. It is the re-running of the appropriate Level III and Level IV tests on the latest revision and the running of the tests requested by MSC during the FACI review. Also, we may have thought up additional level III tests since the original level III activity.

1. Run Additional Tests Suggested by MSC.

(Action to individuals below - need date: 20 December 1968.)

- a. Powered Flight - Peter Adler
- b. Navigation - Peter Volante
- c. Alignments - Don Millard
- d. Rendezvous - Joe Saponaro
- e. Data Links - Jim Kernan
- f. System Tests - George Edmonds
- g. Ascent - Larry Berman
- h. Descent - Bob Covelli and Don Eyles
- i. Aborts - Craig Schulenberg
- j. Special Radar Interface Testing - L. B. Johnson & Pete Volante

2. Re-run of Level III and Level IV. (Action to individuals responsible.)

B. Level VI Testing.

1. AGC Performance Testing Preparation,

The areas we need to emphasize first here are landing, ascent, and aborts, because no confidence in LUMINARY can be built up in these areas as the result of SUNDANCE performance testing. We need some all-digital simulation changes to do performance testing of landings.

- a. Lunar terrain model - slopes and bumps. The Simulator Change Request has already been written. (Action to define when it will be ready to Alex Kosmala - need date for information: 6 December 1968.)
- b. Radar drop-out boundaries. (Action to write Simulation Change Request to Bernie Kriegsman - need date: 6 December 1968.)
2. AGC Performance Testing Test Plan. Bill Marscher and Joe Saponaro have both expressed an interest in this. Mission "F" and "G" planning have probably proceeded far enough to take a cut at this. At any rate, we should be ready to start AGC Performance Testing about 20 December 1968 - the predicted end of Level V testing. (Action to Bill Marscher and Joe Saponaro - need date: 20 December 1968.)
3. Special Testing. A good starting point for this would be the Mission Support Development plan for Mission C' and the SUNDANCE Mission D verification special test plan. (Action to Jim Kernan, Craig Schulenberg et. al. - need date: 27 December 1968.)
4. Mission Procedural Verification Definition and Schedule. (Action to Jim Nevins - need date: to be established.)

C. GSOP Activities.

1. GSOP Section 1. Update required because of PCR 262 (Action to Ain Laats.)
2. GSOP Section 2. Requires an immediate updating because of PCR's in the Data Links area and discoveries made during the FACI review week and the intensive week of downlink testing which took place in the week following FACI review week. (Action to produce new document for review to Bob Tinkham - need date: 9 December 1968.)

3. GSOP Section 3.

New revision required (Action to William Widnall - need date: 20 December 1968.)

4. New manuscript GSOP Section 4.

Document required for review, 12 copies, to be distributed on Monday, 9 December 1968, to reviewers, their comments to be returned no later than 13 December 1968, thence to be incorporated into manuscript and clean white copy to be sent to the publisher on 24 December 1968. (Action to Jack Shillingford and Walker Kupfer - need date: defined above.)

5. Section 5 Change Pages.

Required because of a handfull of PCR's approved and implemented since the document's November release. The action to prepare the change pages was previously assigned. (Action for total package to update Section 5 to Rev. 69 to Bill Marscher - need date: 13 December 1968.)